

## Punctal plugs and dry eyes

By Gemmy Cheung MBBS FRCOphth, Specialist Registrar in Ophthalmology at Birmingham and Midland Eye Centre and Saaeha Raouz PhD FRCOphth, Clinical Senior Lecturer in Ophthalmology / Consultant Ophthalmologist at the Academic Unit of Ophthalmology, Division of Immunity and Infection, University of Birmingham.

### Tear production and drainage

The tear film is composed of three layers: a thin outer lipid (fatty) layer to prevent evaporation, a thick middle aqueous (watery) layer and a thin inner mucin (sticky) layer to enable the tear film to spread evenly. The aqueous component of tears is produced by the lacrimal gland, which is situated under the upper eyelid near the outer corner of each eye (Figure 1). In Sjögren's Syndrome, production of the aqueous layer is greatly reduced. With each blink the tear film is evenly spread across

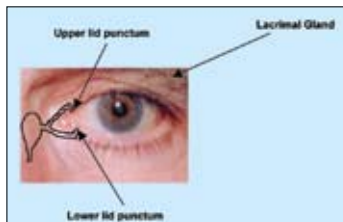


Figure 1: Position of tear punctae.

the surface of the eye. Excess tears drain down the nose via the nasolacrimal system. The punctae situated near the inner corner of each eyelid are the entry point to the nasolacrimal duct tear drainage system. This article describes strategies to reduce tear drainage by the use of various punctal occlusive methods.

### Management strategies of dry eyes

In many dry eye syndromes, tear production by the lacrimal gland is greatly reduced. Your doctor can assess the severity of your dry eyes by performing a Schirmer's test (measuring tear production with sterile tear flow test strips) and looking for dry patches on the surface of the eyes with a yellow dye (fluorescein) or a pink dye (rose Bengal). Milder cases of dry eyes may be adequately controlled simply by avoiding aggravating factors (such as air-conditioning) and tear supplements. There are many preparations available. These differ in their consistency and in whether they contain preservatives. Your eye doctor will be able to advise you further regarding the best choice for you. Sometimes it is a matter of trial and error before you find the preparation that suits you best.

In cases where symptoms are not adequately controlled with the above strategies, occlusion of punctum by either insertion of plugs or cautery have been found to be effective in improving the symptoms and signs of tear deficiency.<sup>1-8</sup>

### Types of punctal plugs

Punctal occlusive devices may be made of many different types of materials. Generally they can be divided into either non-absorbable punctal plugs (Figure 2 below) which consist of an external cap resting on the punctum, and absorbable intracanalicular inserts which are placed entirely inside the lacrimal canaliculus (Figure 2 below).



Figure 2: A diagram demonstrating the site of action of silicon punctal plugs (left) and intracanalicular plugs (right).

### Non-absorbable plugs

The majority of non-absorbable punctal plugs are made of silicone and are based on a cap and anchor design (Figure 3). The cap is designed to lie flush with the skin surface to prevent the plug from descending into the canaliculus whilst the bulb offers internal anchoring to prevent extrusion (Figure 3). They come in different sizes (0.4mm to 1.0mm). There are many variations on a theme



Figure 3: An example of a silicone punctal plug (arrow) with a cap and anchor design resting on the punctum.

to improve comfort or performance. For example flat and slanted cap (FCI Ophthalmics, Marshfield Hills, MA) offer improved profile over the punctum to reduce foreign body sensation (Figure 4); the Flow Controller (Eagle Vision, Memphis, TN) offers a tapered shaft for partial occlusion (Figure 5); the Parasol occluder (Odyssey Medical, Inc., Memphis, TN) is hollow to allow for collapse and easier fit; the PVP Perforated plug (FCI Ophthalmics, Marshfield Hills, MA) has a central perforation for partial flow and is lined with polyvinylpyrrolidone to prevent mucous plugging; the Quintess plug (Cynacon/Ocusoft, Inc, Richmond, TX) offers microreservoir collarette indentations to create a barrier between the plug and the ocular surface; the Snug Plug (FCI Ophthalmics, Marshfield Hills, MA) are packaged preloaded in a stretched position to avoid the need for sizing of the punctum.

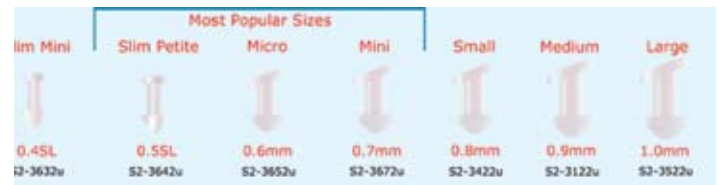


Figure 4: Ready-set plugs (FCI Ophthalmics) with slim design (smaller bulb) and slanted collarette.



Figure 5: A selection of Eagle Vision plugs (from left to right): Super Eagle (improved retention and comfort); Super Flex; Flow Controller (partial occlusion); EagleFlex plug; EaglePlug (the original).

### Absorbable plugs

Absorbable plugs vary in their duration of action. Temporary collagen inserts may be used to assess the effect of punctal occlusion. These disintegrate over a few days. If there is

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noticeable improvement in dry eye symptoms within the first two weeks, the trial is favorable and a more permanent type of plug is likely to be of benefit.

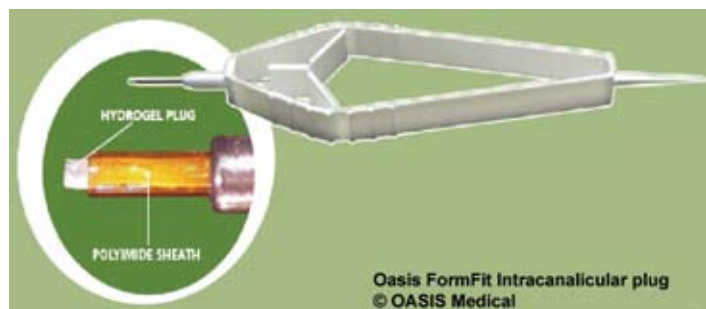


Figure 6: Example of an absorbable intracanalicular plug pre-loaded on the inserter.

Absorbable intracanalicular plugs made of newer materials may last between 3 to 6 months. Their advantages include less irritation as the whole plug is inserted inside the canaliculus leaving no part on the skin surface. The rate of spontaneous extrusion is low. Punctal dilation is often not required as the materials have conforming properties: The Form Fit plugs (Oasis medical, Glendora, CA) (Figure 6) are made of hydrogel which expand on contact with tears whereas the SmartPlug (Medennium, Irvine, CA) is made of a thermo-sensitive acrylic polymer which changes shape on contact with body temperature to conform to the size and shape of the lacrimal punctum. The Herrick plugs come in either absorbable polydioxanone or non-absorbable silicone. They are inserted into the horizontal part of the canaliculus.

### Insertion procedure

The insertion procedure is very simple and pain free. It is usually performed in the eye out-patient clinic at the slit-lamp. First anaesthetic drops are instilled. The punctae may be sized with a special punctal gauge. If necessary, the punctum is dilated by inserting a punctal dilator to ease insertion of the plug. The plug is then inserted either using a preloaded inserter or with forceps (Figure 7 and Figure 8). The whole process usually takes only a few minutes. Often only the lower lid punctae are plugged first. In cases of partial relief or very severe dry eyes, all four punctae may be plugged.



Figure 7: An example of a silicone plug pre-loaded in an inserter.

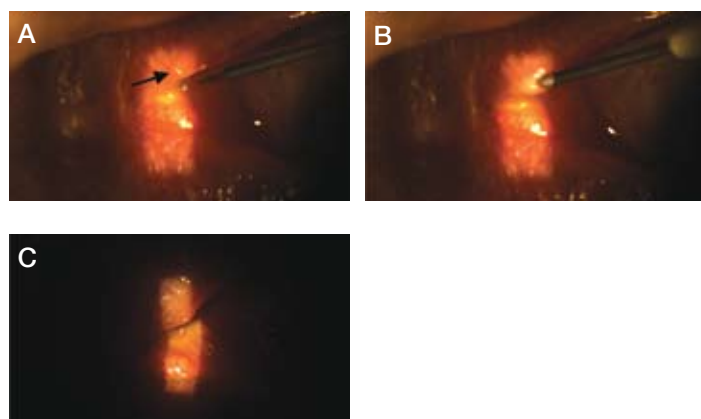


Figure 8: Insertion of plugs (A) The punctum is identified on the slit-lamp (arrow); (B) The tip of the preloaded plug is inserted into the punctum and the plug is ejected by gently squeezing the introducer; (C) After insertion no part of the intracanalicular plug should be visible.

### Punctal occlusion

Permanent punctal occlusion by punctal cautery has been used to treat dry eyes many years before punctal plugs were invented.<sup>9</sup> In the most severe cases of dry eyes this modality of treatment may still be required. This is performed as a minor operation during which the punctum is cauterised under local anaesthetic. The procedure is irreversible.

### Complications

Punctal plugs are usually well tolerated and serious complications are rare. Watery eyes may be experienced by some individuals. Punctal (not intracanalicular) plugs may extrude and require re-insertion. Some people experience foreign body sensation in relation to the position of the cap. Again intracanalicular plugs tend not to be associated with this problem. Rare complications described in the ophthalmic literature include infections, allergy and displacement of the plugs.<sup>12-17</sup> If necessary, punctal plugs can be removed with forceps whereas intracanalicular plugs can be flushed down the nose with lacrimal irrigation.

It is important to remember that punctal plugs are only part of the whole management strategy for dry eyes. Therefore the use of tear supplements will need to be continued, and so does attention towards avoiding aggravating factors.

The authors have no proprietary interest in the products described in this article.

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